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The declining enrolment of New Zealanders in Bachelor of Engineering programmes.

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Abstract
This paper discusses proposed research into the knowledge and attitudes towards professional engineering as a career or field of study held by Year 13 pupils from the Auckland region. An investigation stimulated by the falling enrolment into Bachelor of Engineering degrees by students from most industrialised countries, but more critically by students from within New Zealand itself. The discussion covers comparisons between school pupils from New Zealand and other industrialised nations on the basis of academic achievement, career selection, gender and ethnicity. The proposed methodology, anticipated results, and the possible benefit of those results are also discussed, the author encourages feedback.

Rationale

Student enrolment in bachelor of engineering degrees has fallen during the past decade by around thirty percent in the United States (Kelly, 2001). The situation is similar in other industrialised nations including Japan, Germany and the UK, who are likewise experiencing difficulties attracting and retaining engineering students (Kelly, 2001; Baillie and Fitzgerald, 2000; Rubin *et al*., 2000). A selection of the latest data available from the National Centre for Educational Statistics Website (NCES, 2001) relating to science and engineering enrolment is reproduced below in Table 1.

Table 1. Enrolment trends in science and engineering programmes, United States, 1990 -1997 (NCES, 2001)

	Engineers	Physical Science	Mathmatical Science	Agricultural & Biological	Health fields	Social Science	Computer Science	Environmt Science	Total
1990	107,625	34,075	19,774	61,305	55,043	77,948	34,257	13,984	404,011
1997	101,008	31,108	16,759	68,945	79,460	86,028	36,010	14,644	433,962
Numerical change	-6,617	-2,967	-3,015	7,640	24,417	8,080	1,753	660	29,951
% change	-6.1	-8.7	-15.2	+12.4	+44.4	+10.4	+5.1	+4.7	+7.4

The NCES data for the period 1990 to 1997 indicates that a migration of students occurred from the fields of engineering, physical sciences and mathematical science, to those of health, agricultural and biological science, social science, environmental science and computer science. Despite an overall increase of enrolments into the science fields by around 30,000 students, enrolment into the more mathematically-based programmes such as mathematics, physics, and engineering has fallen by around 12,000 students. Comprehensive enrolment figures are not available for the year 2000. Kelly reports in IEEE Spectrum (Sept. 2001), however, that the available figures show the student migration continues. Interest in electrical, electronic and mechanical engineering is still falling whilst in the computer, biomedical and environmental science fields it is still rising (Kelly, 2001; Wheaton, 2001).

Subtracting foreign student enrolment from the NCES data reveals that the situation is even worse for local engineering students than it initially appears. Foreign student enrolment has been on the increase in recent years in both America (Journal of Materials, 2001; Coy & Whalen, 2001) and the UK (Electronic Times, 2001). Given that these students tend to return overseas once they have graduated

(Coy & Whalen, 2001) the number of engineers likely to move into the US workforce is even less than the data of Table1 suggests.

New Zealand's tertiary education sector report Profile & Trends 2000 (Ministry of Education, 2001) indicates the student enrolment pattern in New Zealand is similar to that of the other industrialised nations referred to above. Although the raw nation-wide enrolment figures are not readily available, a selection of data relating to science and engineering enrolment has been extracted from the report and reproduced in Table 2.

Table 2. Enrolment into science and engineering programmes, New Zealand 1997-2000 (Profile & Trends 2000)

	Engineers	Mathmatical Science	Health fields	Social Science	Computer Science	Natural Sciences
1997	9,621	198	13,909	11,614	5,666	15,218
2000	9,827	150	16,092	12,634	9,300	17,734
Numerical change	206	-48	2,183	1,020	3,634	2,516
Percentage change	+0.2	-24.2	+15.7	+8.8	+64.1	+16.5
Change as %age of total enrolment	-0.2	0.0	+0.5	+0.1	+0.8	+0.5

The data of Table 2 indicates that although student enrolment in the fields of engineering and mathematics was essentially stable for the period 1997 to 2000 it was falling as a percentage of the total enrolment. During the same period however, enrolment in the fields of health, social science, computer science and natural science increased by over 9,000 students as well as increasing as a percentage of the total enrolment. Profile & Trends 2000 (Ministry of Education, 2001) also indicates that New Zealand is below other OECD nations in terms of engineering enrolment at both degree and diploma levels.

Data specifying the enrolment of international students by degree programme was not available. Profile & Trends 2000 did however indicate 11,618 international students enrolled at the tertiary level in July 2000, an increase of 29% from the June 1999 figure, and that the majority of those students came from The People's Republic of China. Chinese students traditionally enrol in business and engineering degrees (Electronic Times, 2001), hence it can be inferred that the enrolment of international students in engineering is also rising and hence the enrolment of New Zealanders is not flat, as might be concluded from the data of Table 2, but is actually in decline. Data relating enrolment engineering by ethnicity and gender was available for the year 2000 (Table 3, p7). It shows that although Pakeha[1] form the majority of student enrolees (68%) they are half as likely to enrol in engineering as are their Asian counterparts, and of those Pakeha who do enrol only 20% are female.

The requirement for graduate engineers has not fallen (Bellinger, 1997; Troy, 2001;). Despite the present high-technology turndown (Electronic Times, 2001) salaries for qualified engineers are high (Marcus, 2001) and demand to fill present positions and to maintain long-term growth is likewise high (Coy & Whalen, 2001). A general shortage of engineers is reported by the Institute of Professional Engineers New Zealand (IPENZ, 2001) and is apparent from the skills shortage lists on the Department of Immigration (DOI) Website for every major New Zealand city (DOI, 12/2001). Growth depends on innovation, and the ability to realise those innovations depends on a steady supply of scientists and engineers (Campbell G, 1999). If the New Zealand government priority to develop the nation as a knowledge society is also taken into consideration it becomes obvious that for the long term benefit of the New Zealand economy it is critical that interest in engineering be rekindled and more, high quality, New Zealand students are attracted into engineering programmes.

[1] New Zealander, non-Maori, European caucasian (Ryan, P.M., 1995)

The intent of the proposed research is to increase the understanding of why such a small proportion of school leavers choose to study engineering. The focus is on Pakeha and Pakeha females as both groups show disproportionately low levels of enrolment in engineering when compared with their Asian counterparts. It is anticipated that the results of this research will give insight into the influences on career choice within New Zealand, and it is hoped that this insight will be used by school career advisors, professional engineering bodies and tertiary institutions as they attempt to match the expectations and aspirations of school leavers with the realities of life as an engineer. Increasing the Pakeha enrolment into engineering courses to proportions similar to those of Asian students would generate an additional 7,000 enrolees per annum and significantly alleviate the shortage of professional engineers in New Zealand.

Literature Review

The International Context:

Declining enrolment of local students in bachelor of engineering courses is a phenomenon common to most industrialised nations including the USA, Japan and Germany. The latest statistics[2] released by such institutions as the NCES (NCES, 2000) show that science fields in general are still attracting increasing numbers of students, however the enrolment trend between 1990 and 1997 was towards programmes related to health, computers, and social science and away from those of physics, mathematics and engineering. While some fields such as civil and biomedical engineering show a slight increase, the fields of electrical, mechanical, and industrial engineering show significant enrolment decline.

A more detailed inspection of the NCES statistics reveals that the situation for science and engineering may be worse than the 1990 to 1997 comparison indicates. Science and engineering enrolment saw a steady increase from 1985 to a peak in 1994 of 504,542 students. Since 1994 a series of declines resulted in only 487,104 students enroling into the science fields during 1997, a reduction of over 17,000 science and engineering students which is opposed to the increase suggested by the 1990 to 1997 comparison. All fourteen fields of engineering show declining enrolments from 1993 to 1997 apart from biomedical engineering which increased by 172 students. Foreign students are included in the NCES enrolment statistics, hence, given that most foreign students return overseas after completing their studies, it can be concluded that the number of professional engineers available for industry in the USA has declined even more significantly than the NCES figures indicate.

Enrolment in engineering programmes within New Zealand mimics that of other industrialised nations. New Zealand's Ministry of Education tertiary sector report (Profile and Trends 2000) notes the falling enrolment in engineering and mathematics, and an increasing number of overseas students. Enrolment specific to Massey University likewise indicates that students opting for the bachelor degrees in Technology, Applied Science and Science (Mathematics) dropped during the period 1996 to 2000 whilst enrolment into bachelor degrees in Information Science and the bachelor of Science increased.

The reason for the global decline in engineering enrolment is complex. Research into career choice has found it to be associated with various factors including ethnic and family influence (Steele & Barling, 1996), encouragement of others, values, gender, academic achievement, salary, working environment, intellectual stimulation, career aspirations (Arbona, 2000; Shipp, 1999) and the anticipation of interesting work (Morgan *et al.*, 2001).

Research by Baillie and Fitzgerald (2000) revealed that potentially high achievers were dropping out of Imperial College, London, for reasons such as not being challenged or not being able to be top of the class. Other students found the courses to be too theoretical and lacking in opportunities for individual pursuit. Jill Tietjen, Dean of Engineering at Colorado University comments in Kelly (2001) that students are bombarded with 'gateway courses' in calculus and physics without doing any of the 'fun stuff'. Dainty *et al.*, (1999) found women to be under-represented at all levels of the construction industry, noticeably at the management level. They found that women had generally been influenced to enter the industry by specific recruitment campaigns rather than advice from friends or family, and that many women were disillusioned by the lack of career opportunities and so were considering leaving the construction industry. It could be speculated that the opinions of previously high achieving students who have not

[2] Graduate enrolment in science and engineering by field of study: United States and outlying areas, fall 1985 to fall 1997, including percent change 1990 to 1997 (NCES, 2000).

enjoyed their exposure to engineering, but who are likely to have been role models during their school years, might well persuade potential engineers to consider alternative courses. Eleanor Baum, Dean of Cooper Union School of Engineering (in Rubin *et al*., 2000) says that "Engineers have been protrayed as techno-nerds and loners", again not the type of reputation which is likely to encourage enrolment.

A number of papers including Bellinger (1997) and Rubin *et al*. (2000) cite students' feelings of poor preparation in mathematics and science as a reason for not pursuing science degrees. Campbell (in Bellinger, 1997) comments that fewer than 15% of American students are sufficiently educated to pursue science majors at college. Adams (1998) focused on the research of gender-related differences in mathematics, reporting that American males were more confident and had more positive feelings about mathematics than did females, and that parental influence on mathematics is more likely to be positive for a son and negative for a daughter. Similarly Arbona (2000), in an article reviewing career literature, concluded that girls had less interest and confidence in mathematics than did boys, and that the major barrier for white female students was their attitudes and early career choices. Morgan *et al*. (2001) likewise noted that despite a narrowing gender-related performance gap of American students in mathematics and science, the gender-related career choice gap in engineering and science persists. Whilst researching the role of interest in career choice, Morgan *et al*. suggest that factors such as anticipated interest and interpersonal goals contribute significantly towards career decisions for women, whereas men more frequently report higher pay and status as influential factors on their career selection. To American students, engineering is perceived as providing high pay and status but is low in interpersonal characteristics. Hence, even from such a simplistic perspective, it seems engineering is more likely to appeal to males rather than females.

The impact which advertising, computer games, and initial computer experiences has on the different genders is discussed by Miller *et al*. (2000). They contend that computers are bought predominantly for, and so appealed to, males rather than females; many of the earlier computer games were combat-related which likewise appealed to males rather than females; a review of computer-related advertising indicated the use of positive images of males working with computers whereas females tended to have been cast in a more 'decorative' role; and when asked about the use of the Internet in their future careers, schoolboys answered more enthusiastically and positively than did schoolgirls. Such findings suggest that the declining enrolment into engineering programmes and the gender-related differences may have as much to do with peripheral factors such as the use of computers as it does with the actual subject matter involved. The prevalent usage of computers in the fields of science and engineering may well perpetuate the gender difference and shall continue to do so unless the female attitude towards computers can be made more positive.

The New Zealand Context:

The New Zealand situation within the context of subject selection and subject competency does not appear to be the same as the international scene discussed above. Table 3, a selection of the latest data available from the New Zealand Ministry of Education website, shows a strong uptake of mathematics and science subjects by Year 13 students and a reasonably balanced male and female enrolment.

Table 3. Enrolment in selected school subjects by Year 13 students, New Zealand 2001

Subject	*M*	*F*	*Total*	*Subject*	*M*	*F*	*Total*
Accounting	2121	2227	4348	English	8461	11320	19781
Art -all types	3797	8053	11,850	Geography	3902	4499	8401
Biology	3421	5406	8827	History	2292	3506	5798
Chemistry	3575	3320	6895	All Maths	13950	10985	24935
Classics	1677	3525	5202	Physical Ed	3858	2900	6758
Computers	2253	1784	4037	Physics	5329	2718	8047

The data indicates that New Zealand students are not deserting the fields of mathematics and science. Additional data from the Ministry of Education Website shows significantly more females than males qualified for university entrance at bursary level from 1997 to 2000, and that for the year 2000 more females (6,932) than males (5,225) enroled in bachelor degrees.

Table 4 shows enrolments into a selection of fields of study according to ethnicity as a percentage of the total enrolment during the year 2000. The data of Table 4 indicates that the interest in mathematics and science shown at a school level does not translate into interest in either computing or engineering. Engineering is significantly less popular than most of the other fields shown, and when ethnic background is taken into consideration it can be seen that, Asians, including Chinese, are twice as likely to select engineering that their Pakeha and Maori counterparts. Of interest also is the consistent rejection of engineering by females. Despite female attendance in school mathematics and science subjects, female dominance in New Zealand Bursaries, and female enrolment in bachelor degrees, the selection of engineering as a career or field of study by females is 30% for Chinese/Indian/Other Asian males and only 20% of Pakeha/Maori males.

Table 4. Enrolment into fields of study by ethnicity and percentage of total enrolment, New Zealand 2000

Ethnicity (% of total popln) *Field of Study*	Pakeha (68%)	Maori (14%)	Chinese (5.2%)	Indian & Other Asian (3.9%)
Humanities	6.9%	1.7%	0.5%	0.4%
Education	7.7%	1.7%	0.1%	0.2%
Commerce	18.6%	3.0%	1.9%	1.2%
Computing	2.4%	0.8%	0.3%	0.3%
Engineering (enrolment M/F)	2.7% (6,417/1,230)	0.2% (571/102)	0.5% (1,008/334)	0.4% (792/268)
Health	4.7%	0.7%	0.3%	0.3%

From an international perspective a number of initiatives have been taken in an effort to revitalise engineering enrolment. These include awareness programmes for K-12 students (Troy, 2001); an online guide to engineering at www.nacme.org; closer links between industry and education; and the inclusion of an engineering education programme from the U.S. Military academy (Rubin *et al*, 2000). Educational institutions around the world such as Smith College, Massachussetts, the University of Colorado, and the University of Applied Sciences, Solothurn, Switzerland are moving away from the traditional first year engineering programme dominated by mathematics and physics, and towards more project-based work spread throughout the curriculum (Kelly, 2001). Within the New Zealand context such changes are not obvious. The information contained on the websites for those institutions offering engineering degrees[3] indicates that they offer traditional design and development courses and although a recent Ministry of Education initiative (NAG1/vi) stipulates career guidance from Year 7 onwards, it shall be some years before the effects of this initiative are known. The papers reviewed to date, however, make no reference to the theoretical underpinning for such curriculum initiatives, and none presupposes success.

In summary, much of the industrialised world is experiencing declining enrolment in Bachelor of Engineering programmes. Embedded in that declining enrolment is the knowledge that fewer pupils are pursuing mathematics at school than in previous years and significantly fewer females than males choose engineering as a career. International research indicates females tend to choose careers such as teaching and nursing which exhibit interpersonal traits and that females are less positive about computers in general and the opportunity of new technologies such as the Internet. On the other hand males tend to choose careers such as engineering which afford high salary and status, and males are generally more positive about computers and the use of the Internet. The New Zealand context differs from that of its international counterparts, however, in terms of the school pupil's preparation for engineering as a field of study. Unlike many other countries, New Zealand school pupils have maintained an interest in mathematics and science and many graduate from school with results which permit them to enrol in engineering courses. Additionally females out-perform males academically in New Zealand, yet despite their ability the female trend of avoiding engineering mimics that of other industrialised nations.

[3] Auckland University, Auckland University of Technology, Canterbury University, Lincoln University, Manukau Institute of Technology, Massey University, Waikato University

In New Zealand the largest major ethnic group (Pakeha) which also forms the largest proportion of tertiary students (68%), has the lowest proportional enrolment (2.7%) into bachelor of engineering courses. Additionally the ratio of Pakeha females to males enrolling in engineering courses is lower than from other major ethnic group. If the level of interest in engineering amongst Pakeha in general could be lifted to compare with the interest shown by Asians, enrolment in engineering courses would increase by some 7,000 students. This is a factor which would significantly alleviate the shortage of professional engineers in New Zealand, as well as assist in the government drive towards a 'knowledge economy'.

It is proposed that research, similar to that conducted overseas by Morgan *et al*. (2001), be carried out within the New Zealand context in an effort to better understand what influences New Zealand school leavers career choice. Whether the falling enrolment in engineering is the result of family or official career advice, peer pressure, computer-phobia, or problems of an academic nature, it is unlikely to be reversed unless the cause is better understood.

Research Questions

The central objective of the proposed research is to better understand why New Zealand school leavers do, or do not, choose engineering as a career. To achieve this it is proposed to assess the pupils' knowledge about professional engineering, their career expectations in general, their expectations of engineering as a possible career, and who or what has influenced those attitudes and expectations. Assessment of the pupils' knowledge, attitudes and the origins of those attitudes will be achieved by analysis of their answers to a series of questions related to those major areas:

Knowledge about engineering:	
What is the knowledge-base relating to?	*How was that knowledge gained?*
Providers of engineering courses?	Friend/relative is engineer?
Different types of engineer?	Advice from school careers department?
Gender ratio of engineers?	Visits - industrial/Academic?
How engineers contribute to society?	Publicity through media?
Surplus/shortage of engineers in society?	Personal research?
International recognition of a New Zealand engineering qualification?	

Expectations of careers in general	***Expectations of engineering as a career***
What is the importance of: Interesting work/Salary/Status/Computer-usage/Job-mobility/Continuous employment?	What is considered the likelyhood of: Interesting work/Salary/Status/Computer-usage/Job-mobility/Continuous employment?

Who or what has influenced the attitudes and expectations expressed above?
Friends/Relatives/Mentors/Role models/Media/Personal research

Attitude towards engineering as a career for Women
Discussion answer for content analysis.

The list of topics above is not considered exhaustive and modification is expected as a result of the pre-pilot and pilot phases of this research.

Survey Population

The population to be studied will be those pupils who are studying in Year 13 at New Zealand state and private schools in the Greater Auckland region[4]. Year 13 has been chosen as not only are these students potential enrolees into the Bachelor of Engineering degrees, but they should also be those who are most aware of what they want to do when they leave school and of what influenced that decision. Morgan *et al*. (2001) targeted US college freshmen, who are essentially the same age group as Year 13, as they are at the point where they have an abundance of educational choices and are aware of the importance of career decisions. It is also the point where the greatest loss of women to the mathematics/science pipeline

[4] The Auckland region consists of: Auckland City, Franklin District, Manukau City, North Shore City, Papkura District, Rodney District, and Waitakere City.

occurs. The New Zealand Ministry of Education (NZMoE) Website rolls (July 2001) indicates a total of 10,433 school pupils excluding those attending correspondence and special education schools. It is proposed to omit the correspondence and special needs schools because of probable difficulties in accessing the pupils and the disruption the research might cause. The survey population is close to 30% of the total population of Year 13 pupils in New Zealand and consists of 5,180 male and 5,253 female pupils.

Methodology

Data generation

In order to discover why some eligible school leavers choose to study for a Bachelor of Engineering degree while others do not, this investigation proposes to survey pupils who are studying in Year 13. A number of data-gathering methods are available which could elicit the opinion of the pupils typically questionnaires, attainment tests and interviews. The use of interactive data-collection procedures such as face-to-face or telephone-interviews are precluded by the cost, in terms of both time and money, resulting from the sample size and disbursement. A self-administered questionnaire is intended to gather data reflecting personal opinion hence the personal bias inherent in the process does not pose a threat to the validity of the results(Page & Meyer, 2000). Consequently a self-administered questionnaire, supervised by a member of the school staff, is the most appropriate instrument in this case.

Given the resource and time restraints it is not feasible to gather data from the entire population. Consequently it will be necessary to employ a research method that permits results from a sample of a population to be inferred as reflective of the whole. Stratified random sampling, a technique whereby the population is grouped according to some relevant characteristic and then randomly sampled, will be used. The strata for this research will be the pupils of Year 13 classes from within the Auckland region grouped by gender, school gender-type, and governing authority.

The required sample size is influenced by: the size of the population the sample seeks to represent; the number of variables in the data gathering instrument; the requirement for statistical analysis; and the degree of confidence required from the results (Cohen & Manion, 1994; Page & Meyer, 2000). A minimum sample size for standard inferential statistics is 30 (Bouma, 1996; Cohen & Manion, 1994; Page & Meyer, 2000), however Bouma (1996) suggests that when an analytical matrix is being used, the sample size should be five times the number of boxes in the matrix. Sekaran (1992, p253) provides the generalised scientific guideline relating sample size and population size, it indicates that for the Year 13 population of 10,000 the sample size should be 370. The sample size however represents the number of correctly completed questionnaires that must be returned so that the results of any statistical analysis can be generalised to the whole population with sufficient levels of confidence. Hence consideration must be given to the possible proportion of unreturned and incorrectly completed forms in order to determine the minimum number of questionnaires that should be administered. It is anticipated that the response rate should be relatively high as the questionnaire is to be supervised by a member of the school staff and additional techniques such as follow-up telephone calls can be employed. Anticipating a response rate in the order of 50% means that around 800 questionnaires will need to be distributed.

Table 5 shows the questionnaire distribution throughout the strata, maintaining the questionnaire/sample-population ratio equal to the strata-population/survey-population ratio.

Table 5. Sampling populations of Year 13 pupils within Greater Auckland, based on school gender type and schools authority, July 2001. (Based on Table 3, p8 - Population strata within the Auckland Region.)

Strata samples of Year 13 Pupils - Auckland Region				
School Authority	**School Gender-type**	**Male**	**Female**	**Totals**
State	**Coeducational**	261=32.6%	250=31.3%	511=63.9%
	Single-sex-M	94=11.8%	0	94=11.8%
	Single-sex-F	0	105=13.1%	105=13.1%
	(State Total)	(355=44.4%)	(355=44.3%)	(710=88.7%)
Private	**Coeducational**	16=2.0%	25=3.1%	41=5.1%
	Single-sex-M	26=3.2%	0	26=3.2%
	Single-sex-F	0	23=2.9%	23=2.9%

	(Private Total)	(42=5.2%)	(48=6.0%)	(90=11.2%)
	Grand Totals	**397=49.7%**	**403=50.3%**	**800=100%**

Survey instrument design

The survey instrument will be a self-administered questionnaire, the front cover of which will consist of a title, an introduction to the research, and the questions which establish the respondent's relationship to the population sample in terms of school gender type, gender, geographical location and the respondent's ethnicity. The pages which follow will contain questions grouped by the major question categories: knowledge of engineering, general career expectations, engineering career expectations, attitude towards engineering as a career for women, and influences of attitudes and expectations. Additional categories of questions may be included as a result of the pilot and pre-pilot phases of this research.

Pre- pilot Survey

A pre-pilot survey consisting of semi-structured interviews will be conducted among Massey University students who have recently enrolled into first year programmes. The purpose of the pre-pilot phase of the research is to generate and develop question ideas for the survey instrument. Thirty students will be interviewed from a variety of backgrounds. The interviewees will be divided equally across the enrolments for engineering, science, and non-science. The interviewees will also be drawn from both genders and from a variety of ethnic backgrounds. Ethical approval will be sought for the pre-pilot phase by following the Massey University guidelines for research on human subjects/Massey University students.

Pilot Survey

Piloting the above survey instrument will be done on a convenience, or accidental sampling, basis with a view to testing the unambiguous nature of the items within the questionnaire and its ability to elicit the desired information. The pilot questionnaire will contain additional open-ended questions designed to gather information on areas that seem relevant to the pupils but which are omitted from the original design. A simple random selection of three schools within the Greater Auckland region that have not been included in the population sample will be used to pilot the questionnaire.

Conclusion

The results of this empirical research will provide greater understanding of Year 13 pupil's in New Zealand, in respect of their knowledge about the field of engineering, attitudes towards engineering as a career, and what has influenced those attitudes. It will provide information to professional engineering associations, school and tertiary education establishments, and school career advice officers as to how they should portray engineering as a career. It is hoped that this improved information will lead to an increase in enrolment into engineering programmes from pupils of all backgrounds, but especially those presently underrepresented.

It is anticipated that some of the results will delineate along gender lines hence revealing some factors, say prevalent computer usage, that is depressing female enrolment in engineering programmes. Such an occurrence would suggest further research into attitudes towards computers in order to more accurately identify the contributing circumstances.

The research results may also indicate negative impressions of engineering being expressed by those already enrolled in engineering degree programmes. Such impressions could be the result of unrealistic expectations on the part of the student, uninspiring or irrelevant course material or the impact of a relatively high drop out rate (typically 50%) during the first two years of the programme. Again, further research may be necessary to more accurately identify the source of such possible discontent.

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